Claims

1. Process for the production of electricity in a fuel cell from hydrocarbons that comprise a partial oxygenation stage of hydrocarbons, characterized in that

a) A stream (1) that contains a hydrocarbon feedstock with boiling points that are less than about 400°C is fed

b) The stream is preheated to a temperature of at least 200°C, enough so that said stream is entirely evaporated,

c) An air-carrying gaseous oxidant stream (2) is fed, and the oxidant stream is preheated to a temperature of at least 400°C

d) The two gaseous streams are reacted in a partial oxidation zone (3) or chamber, whereby the operating conditions of this chamber are in the following range:

-- Dwell time in the chamber of between 100 and 1200 milliseconds

-- Output temperature of the chamber of between 1150 and 1650°C

-- Pressure of the chamber of between 0.1 and 1.5 MPa, and preferably 0.15 MPa to 0.8 MPa

whereby the output temperature of the chamber is adequate so that at least 90% of the carbon of the feedstock is converted into CO or CO2 and that the amount of soot contained in the effluent is less than 0.1% by weight relative to the feedstock, preferably

between 0.5 ppm and 100 ppm (1 ppm = 1 part per million)

e) The effluent of the chamber is cooled (5) to a temperature of between 200°C and 1050°C and preferably between 500°C and 900°C

f) The cooled effluent is circulated in at least one zone for recovery and treatment of soot that comprises a first circuit (6) comprising at least a first filter (7) and a second circuit (41) that are mounted in parallel; a stage for filtration of the effluent in the first filter is carried out for a period of time in order to deposit soot there; the first filter containing the soot is regenerated in the presence of a gas that contains oxygen for another period of time, and during said other period of time, the cooled effluent is circulated in the second circuit, whereby said first filter has a high density such that the filtration surface area/useful volume ratio is between 80 and 5000 m^{-1}, and a hydrogen-rich effluent that is exiting the recovery zone is recovered

g) A fuel cell (10) is fed by at least a portion of the effluent that is exiting the recovery zone.

2. Process according to claim 1, wherein the second circuit contains at least one soot filter (14).

3. Process according to claim 2, wherein the filter of the second circuit contains a vapor reforming catalyst of the soot

that is collected to gasify it while the first filter is regenerated.

4. Process according to claim 2, wherein the filter of the second circuit is regenerated in the presence of a gas that contains oxygen for at least a portion of the period of time of the filtration stage in the first filter.

5. Process according to one of claims 1 to 4, wherein regeneration effluents of the first filter are drawn off from the first circuit.

6. Process according to one of claims 1 to 5, wherein the gaseous oxidant stream and/or the hydrocarbon feedstock contains water vapor in an H2O/hydrocarbon mass ratio of between 0.1 and 2.0, preferably of between 0.4 and 1.2.

7. Process according to one of claims 1 to 6, wherein the oxygen content of the effluent that exits the recovery zone is measured.

8. Process according to one of claims 1 to 7, wherein at least one at least partial elimination stage of the hydrogen sulfide and carbon monoxide of the effluent that is obtained from the recovery zone is carried out.

9. Process according to one of claims 1 to 7, wherein the fuel cell is an electrolyte-type cell with solid oxide (SOFC).

10. Process according to one of claims 1 to 8, wherein the fuel cell is a polymer electrolyte cell (PEMFC type) or a phosphoric acid cell.

11. Process according to one of claims 1 to 10, wherein the operating conditions of the partial oxidation zone are modified

during the regeneration periods of the first filter to reduce the amount of soot produced during said periods and circulating in the second circuit.

12. Device for the production of electricity according to one of claims 1 to 11 that comprises in combination:

-- A circuit (1) for feeding an air-rich oxidant stream that is connected to at least one heat exchanger (5) for the reheating of said stream,

-- At least one partial oxidation chamber that is connected to heat exchanger (5) and to a feed stream (2) of a hydrocarbon-rich stream for the partial oxidation of hydrocarbons for the reheated oxidant stream at an adequate temperature for obtaining a conversion of the hydrocarbons that is higher than 90% and the formation of soot in an amount that is less than 0.1% by weight relative to the hydrocarbons

-- Partial oxidation chamber (3) that is connected downstream to the exchanger

-- Soot recovery and treatment means that have an inlet connected to heat exchanger (5) and that comprise a first circuit (6) that comprises at least a first filter (7) and a second circuit (41) that are mounted in parallel, whereby the first filter also comprises regeneration means (20, 21) that are sequential by soot combustion, whereby the first filter has a filtration surface area/useful volume ratio of between 80 and 5000 m^{-1} and preferably between 150 and 1500 m^{-1}, and whereby

the recovery and treatment means have an outlet (9) for effluents from which soot has been removed and that are rich in hydrogen,

-- At least one fuel cell that is connected to the outlet of the effluents of the recovery and treatment means, suitable for producing electricity,

-- Means for alternating use of soot recovery and treatment means (30, 31, 32, 35) that are connected to regeneration means of first filter (20, 21).

13. Device according to claim 12, wherein means (30) for alternating use comprise means (33, 34) for modification of the operating conditions of the partial oxidation chamber during regeneration periods of the first filter for the reduction of the amounts of soot produced during these periods and that circulate in the second circuit.

14. Device according to one of claims 12 to 13, wherein the second circuit comprises a soot filter.

15. Device according to one of claims 12 to 14, wherein means (50, 51, 52, 53) for clean-up of effluents are inserted between the outlet of the soot recovery and treatment means and fuel cell (10).

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